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ABSTRACT

This publication deals with suggested maintenance standards that apply to vehicles used for pupil transportation in California and covers all the safety-related systems that are common to most buses. The guide has been prepared to help all school bus and school pupil activity bus operators set up an inspection and preventive maintenance program that will meet the need to conform to the California Vehicle Code sections, and it could be used as a training aid for bus drivers, mechanics, service personnel, driver trainers, and supervisory personnel. Suggested forms that operators may use in developing an inspection and maintenance program are included. The chapters contain information about (1) daily and weekly bus inspections with checklist and reports; (2) setting up a vehicle inspection and preventive maintenance program that meets state requirements; (3) the records required for controlling and evaluating a preventive maintenance program; and (4) the facilities, equipment, and personnel needed for shop maintenance and repair of school buses. (MLF)

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CALIFORNIA STATE DEPARTMENT OF EDUCATION
Wilson Riles, Superintendent of Public Instruction
Sacramento, 1978

School Bus and School Pupil Activity Bus Inspection and Maintenance Guide

Prepared under the direction of

Fred W. Sowash
Project Assistant
BUREAU OF MANAGEMENT SERVICES

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Foreword

The safe transportation of school pupils to and from school and school-related activities is a serious responsibility that is shared by regulatory and law-enforcement agencies, school personnel, motorists, the pupils themselves, and anyone who furnishes transportation for school pupils. An essential part of meeting this responsibility is making sure that vehicles used for transporting pupils are regularly and carefully inspected and maintained.

This publication, *School Bus and School Pupil Activity Bus Inspection and Maintenance Guide*, deals with suggested maintenance standards that apply to vehicles used for pupil transportation in California.

We are confident that conscientious application of the information in this guide will result in transportation systems that are efficient, economical, adequate to the needs of the community, and above all—safe.

Commissioner, California Highway Patrol

Superintendent of Public Instruction

Preface

The large number of pupils being transported to and from school and school-related activities daily in California requires a safety program that conforms with state regulation and control. This guide has been developed to assist the many dedicated men and women who have the responsibility for inspecting and maintaining school buses and school pupil activity buses in all parts of the state.

The guide covers all of the safety-related systems that are common to most buses, regardless of their make. Its purpose is to provide information and examples that will help bus maintenance personnel and drivers gain a better understanding of the importance of regular inspection and maintenance in the interest of greater safety. The need for such a manual is clear—experience has shown that many road failures and accidents involving school buses and school pupil activity buses can be attributed at least in part to a failure of either vehicle inspections or maintenance of the systems covered in this guide.

This publication was prepared under the direction of Fred W. Sowash, Field Representative in the Bureau of Management Services, in cooperation with the California Highway Patrol, Commercial Vehicle Section. Consultant services were provided by William C. Spinks, President of the Taylor Bus Company, Anaheim, California.

WILLIAM D. WHITENECK
Deputy Superintendent
for Administration

JACQUE T. ROSS
Associate Superintendent and Chief,
Division of Administrative Services

JOHN E. LAW
Commander, Commercial Vehicle Section
California Highway Patrol

JACK LIEBERMANN
Chief, Bureau of
Management Services

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Chapter I
Introduction

Legal Basis and Purpose of This Guide

School Bus Inspection (Vehicle Code 2807)

(a) The California Highway Patrol shall inspect every school bus at least once each school year to ascertain whether its construction, design, equipment, and color comply with all provisions of law.

(b) No person shall drive any school bus unless there is displayed therein a certificate issued by the California Highway Patrol stating that on a certain date, which shall be within 13 months of the date of operation, an authorized employee of the California Highway Patrol inspected the bus and found that on the date of inspection the bus complied with the applicable provisions of state law relating to construction, design, equipment, and color. The Commissioner of the California Highway Patrol shall provide by rule or regulation for the issuance and display of distinctive inspection certificates.

Inspection of Other Motor Vehicles Transporting Pupils: Display of Inspection Certificates (Vehicle Code 2807.1)

(a) The Department of the California Highway Patrol shall inspect and certify every vehicle specified under subdivisions (d) or (e) of Vehicle Code Section 545 which is occupied, aside from the driver, exclusively by school pupils or exclusively by school pupils and persons accompanying them for supervisory purposes, to which the use by the general public is prohibited by the carrier under a contract or agreement with the school and which is being operated to transport pupils to and from a public or private school activity, at least once each year to ascertain whether its condition complies with all provisions of the law.

(b) No person shall drive any motor vehicle specified in subdivision (2) unless there is displayed therein a certificate issued by the Department of the California Highway Patrol stating that on a certain date, which shall be within 13 months of the date of operation, an authorized employee of the Department of the California Highway Patrol inspected such motor vehicle and found that on the date of inspection the bus complied with the applicable provisions of the state law. The Commissioner of the California Highway Patrol shall provide by rule or regulation for the issuance and display of distinctive inspection certificates.

Preventive Maintenance Inspections (Vehicle Code 2807.2)

The Department of the California Highway Patrol, by regulation, shall provide for a preventive maintenance inspection guide for weekly use by operators of motor vehicles specified in Vehicle Code sections 2807 and 2807.1. The regulations shall provide that such record of inspection shall be signed by the persons making such inspection, and the record of such inspections shall be retained on file by the operator for review and inspection by the Department of the California Highway Patrol.

This guide has been prepared to help all school bus and school pupil activity bus operators set up an inspection and preventive maintenance program that will meet the need to conform with the above Vehicle Code sections.

This guide goes far beyond the scope of the laws and regulations governing inspection and maintenance programs. Its intent is not only to explain conformance with the above Vehicle Code sections but also to help operators who do not have a sound overall preventive maintenance program.

This is an example of one preventive maintenance program that if used should place an operator into an A or B rating issued by the Department of the California Highway Patrol. This is not to say that this is the only acceptable program. Many other programs used by operators in the state are good basic programs.

This guide could be used as a training aid for bus drivers, mechanics, service personnel, driver trainers, and supervisory personnel. This guide contains some examples of maintenance records that could be used by school districts for compiling expense information that would be of value when the Annual Transportation Report is filed (J-141).

Importance of Bus Inspection and Maintenance

Buses of many makes, types, sizes, and shapes are used to transport pupils. However, most of the buses now in service are quite similar with regard

to inspection and maintenance. Components may vary, but each vehicle has the same basic systems that perform the same basic functions.

A bus is a complex piece of equipment in which thousands of parts are combined to make up a great many assemblies and systems, all of which must work together correctly if the bus is to provide safe, reliable, and economical transportation. Correct inspection and maintenance are therefore necessary for every bus from the moment it is delivered, throughout its service life, and until it is retired. A new bus should be carefully checked out before it is placed in service. From then on, daily inspection of certain systems must be made, followed by periodic and major inspections of *all* systems, as suggested in this guide, to ensure that the bus will function safely and efficiently at all times.

Maintenance Personnel

Qualified maintenance personnel are essential to the success of an inspection and maintenance program. They must be sufficiently skilled and adequately equipped to follow an inspection and maintenance plan that is systematic and thorough.

Recordkeeping and Forms

A planned inspection and maintenance program includes the keeping of records that will provide a history for each vehicle. Orderly records enable the operator to keep track of vehicle mileage, running time, and maintenance costs; and such records indicate to maintenance personnel what has been done to the vehicle, when it was done, and what must be done next. Also, such records are required to be retained on file for review and inspection by the California Highway Patrol. (The important part that CHP motor carrier inspectors play in the school bus and school pupil activity bus inspection and maintenance program will be explained in Chapter IV of this guide.)

Suggested forms that operators may use in developing an inspection and maintenance program are included throughout this guide. The forms may be copied and used as is, or they may be modified to fit any special requirements of the operator's program. Obviously, no single set of procedures like the one presented here will exactly fit every vehicle in every program in the state. Operators will have to tailor their procedures to fit their own equipment.

One of the main considerations in reaching any degree of uniformity is consistency with regard to recordkeeping and forms. For this reason, operators who are developing or modifying forms may want to consider the formats suggested in this guide.

Chapter II
Daily and Weekly Bus Inspections

Inspections, Checklist, and Reports

Daily Inspection by Driver

Each school bus and school pupil activity bus being used to transport pupils shall be inspected daily by the driver to ascertain that it is in safe condition and equipped as required by all provisions of law and that all equipment is in good working order. No pupil shall be transported in the bus until any defects discovered have been corrected.

Checklist

The use of a checklist of each item to be inspected during a daily bus pretrip inspection has been found to be very helpful. Many operators have found such a checklist of value when training new drivers. Such a checklist effects time savings and becomes a step-by-step vehicle inspection procedure. A checklist has also been found of value in grading drivers on performance of their daily inspection procedure during inservice training programs.

A sample checklist has been developed for this purpose for consideration. (See Fig. II-1.) In many cases it could be used "as is"; or it could be modified to fit the needs of a particular type of bus. It is suggested that when a checklist, such as the example, is developed that it be designed to prevent lost motion during the checkout procedure. With this in mind, the inspector should inspect all items in the order in which they appear on the checklist with a starting and ending point. This way he or she has the assurance that nothing has been overlooked.

Reporting Defects

When the driver discovers a defect or a malfunction during an inspection, during or after a run, or at any other time, he or she shall make a written report of the defect or malfunction to the employer.

Vehicle Condition Report by Driver (Title 13-1215b and 1234e)

Each bus carrier shall require drivers to report on vehicle condition, and every driver shall write such a report at the completion of his or her day's work or tour of duty. Whether discovered by or reported to the driver, all vehicle defects and deficiencies likely to affect safe operation or cause mechanical breakdown of the vehicle shall be listed; and a negative report shall indicate that no such conditions are present. Reports shall be carefully examined, defects shall be checked and corrected, and operators shall retain reports for at least one month.

Any vehicle that the owner or driver knows to be unsafe or not equipped in the manner required by law may not be used to transport pupils until:

1. The vehicle has been examined and repaired or equipped as required by law.
2. A competent mechanic has certified that the vehicle is safe and is equipped in compliance with the law. (Title 12-1215b and 1234e)

To comply with Title 13-1215b and 1234e, several methods are used. One thing that must be kept in mind when developing any forms to use for this purpose is that the driver must conduct a daily vehicle checkout. Also a line of communication must be maintained between the operator and the driver, communication that reflects completion of an action and the reporting of all defects.

The following are suggestions on how this may be accomplished:

1. Use the example form by having the driver mark each appropriate box on the right side of the page, and by having him or her sign the form and turn it in to the operator each day. (See Fig. II-1.)
2. Use the following example (Fig. II-2).

These are only two examples of forms that could be used. Whenever a new form is being developed or whenever assistance is needed, check with the Department of the California Highway Patrol Motor Carrier Operations Specialist (MCOS).

Weekly Inspection (Title 13-1232b and 1234f)

In addition to the driver's daily vehicle inspection and written report, a weekly vehicle inspection and maintenance is required by the operator.

WEEKLY CONDITION REPORT FOR SCHOOL BUSES AND SCHOOL PUPIL ACTIVITY BUSES (SPABS)

Bus No. _____ (Vehicle license number or other positive identification)

Make and model _____

Employer _____

Perform the checks in the order indicated. Mark each item in the box at the right (mark "✓" if the item is O.K.; "X" if the item requires repair or maintenance; "0" if the item does not apply to this vehicle). After making all the required checks, enter the date of the inspection and sign your name. Also, note in the appropriate blank at the bottom of the page when the next service will be due for this vehicle.

Day performed (circle): Monday Tuesday Wednesday Thursday Friday Saturday Sunday

1. Water and oil levels	
2. Belts, radiator hoses	
3. Start engine; check oil pressure	
Set hand throttle (800 to 1,000 rpm)	
4. Ammeter and voltmeter (proper readings)	
5. Air/vacuum gages (adequate buildup)	
6. Fuel gage	
7. Driver's seat and seat belts	
8. Horns (air and/or electric)	
9. Entrance door	
10. Modesty panels and handrails	
11. Interior lights, step-well lights	
12. Heaters, defroster, fans	
13. Windshield (clean, free of defects)	
14. Windshield wipers and washers	
15. Mirrors (clean, properly adjusted)	
16. Fire extinguisher (charged, sealed)	
17. Flares, reflector type (3)	
18. First-aid kit	
19. Passenger seats	
20. Floor covering (clean, secured)	
21. Windows and latches	
22. Emergency exits	
23. Emergency exit warning devices	
24. Temperature gage	
Recheck throttle setting (800 to 1,000 rpm). Turn on all outside lights (headlights on high beam, directional signals to left).	
25. Headlight high-beam indicator glows; left directional signal indicator flashes	
Check items 26 through 58 from outside the bus.	
26. Front top running lights	
27. Front red crossover lights	
28. Front "School Bus" sign	
29. Headlights (high beam)	
30. Fog lamps	
31. Left front directional light	
32. Left mirror securement	
33. Left front clearance light	
34. Left side directional light	
35. Left front tire, wheel, lug nuts	
36. Left side body panels, reflectors	
37. Left center clearance lights	
38. Left side emergency door or exit	
39. Left rear tires, wheels, lug nuts, axle flange	
40. Left rear clearance light	
41. Rear top running lights	

42. Rear red crossover lights	
43. Rear "School Bus" sign	
44. Rear emergency door or exit	
45. Left rear directional light	
46. Stoplights	
47. Taillights and license-plate light	
48. Reflectors	
49. "Stop When Red Lights Flash" sign	
50. Right rear clearance light	
51. Right rear tires, wheels, lug nuts, axle flange	
52. Right side emergency door or exit	
53. Right side body panels, reflectors	
54. Right center clearance lights	
55. Right front tire, wheel, lug nuts	
56. Right front clearance light	
57. Right mirror securement	
58. Crossover mirrors	
Reenter bus, change directional signals to right and dimmer switch to low beam; recheck throttle setting (800 to 1,000 rpm).	
59. Temperature gage (recheck)	
60. Headlight high-beam indicator off; right directional signal indicator blinks	
Check items 61 through 64 from outside the bus.	
61. Headlights (low beam)	
62. Right front directional light	
63. Right side directional light	
64. Right rear directional light	
Reenter the bus and cancel all lights except those necessary to operate the bus. Before operating the bus, perform the tests required to check items 65 through 75 (brake safety check).	
65. Air-pressure gages	
66. Governor cut-in/cut-out pressures	
67. Static pressure loss (not over 2 psi per minute)	
68. Pressure loss w/brakes applied (not over 3 psi per minute)	
69. Low pressure warning devices	
70. Emergency stopping system	
71. Air brake adjustment	
72. Parking brake test	
73. Antilock/121 system	
74. Split axle protection system	
75. Hydraulic brake system	
76. Capacity/CHP inspection card	
77. Two-way radio (proper operation)	
78. MAKE TWO BRAKE TEST STOPS BEFORE LOADING STUDENTS.	

SAMPLE

Next service due (mileage or date):

A _____ B _____

C _____ D _____

I have inspected this bus on (enter date): _____

_____

(Signature of person making inspection)

Fig. II-1. Sample weekly condition report form

TRANSPORTATION DEPARTMENT
DEFECT REPORT

Bus No. 1410

Defects:

1. Step-well light out
2. Type A service due
3. Speedometer needle bounces
4. Torn seat cushion in row 4
5.
6.
7.
8.
9.
10.

Driver's signature Mike Hart Date: 7/20/77

For Shop Use Only

Repairs made:

1. Replaced bulb
2. Completed Type A service
3. Greased cable
4. Repaired cushion
5.
6.
7.
8.
9.
10.

Mechanic's signature Chris P. Brown Date: 7/21/77

SAMPLE

Fig. II-2. Sample defect report form

This inspection and maintenance may be conducted by preventive maintenance personnel or a school bus driver qualified to perform preventive maintenance and shall include, but not be limited to, the following:

1. Maintain all vehicle fluid levels in accordance with the manufacturer's recommendations.
2. Check all guages, buzzers, and indicators to determine whether they are working.
3. Test horns.
4. Check driver's seat and belts for wear and securement.
5. Determine that all doors, door emergency releases, and windows are in operating condition.
6. Check the securement of all seats, handrails, and modesty panels.
7. Check all interior and exterior lighting systems.
8. Determine that all heating, cooling, and ventilation systems are working.
9. Check all glass and mirrors for cracks and cleanliness.
10. Determine that windshield wipers and washers are working.

11. Determine whether emergency equipment, as required, is maintained and is in operating condition.
12. Check all tires and lug nuts.
13. Perform the following brake safety check:

    a. Check air compressor governor cut-in and cut-out pressures.
    b. Check static pressure for air loss.
    c. Test the applied brake pressure loss.
    d. Test low air pressure warning devices.
    e. Test emergency stopping system.
    f. Test parking brake.
    g. Test anti-skid device.
    h. Check hydraulic brake system to determine that the vacuum guage reads not less than 15 inches.
    i. Test low vacuum warning device system.
    j. Check brake pedal for brake adjustment.

Inspection on Other Than a Weekly Basis (Title 13-1232c)

A preventive maintenance inspection by the bus operator is to be conducted every 2,000 miles, or 30 working days, whichever occurs first, or in accordance with the manufacturer's recommended maintenance schedule if such schedule specifies less than 2,000 miles and 30 working days. This inspection shall include, but not be limited to, checking the following:

1. Brake adjustment
2. Hydraulic brake fluid leaks
3. All tank mounting brackets
4. All belts and hoses for wear

It is suggested that someone, other than the driver, who has a mechanical background inspect the vehicle once each week for mechanical deficiencies. This procedure would build in a check and balance system to find or inspect items that a driver may not find during a daily bus checkout. However, the weekly in-depth inspection may be performed by a driver or by any other person designated by the operator who has been trained to do this inspection.

For training purposes, an operator may consider the form in Fig. II-1.

As indicated on the checklist, each item is numbered. On the following pages, by numbers corresponding with those on the form, is an explanation of how to look and what to look for. This is only a suggested method used by some operators as a teaching device, so the method may have to be altered to fit a particular vehicle. A checklist method of inspection has been proven to be the best method for conducting any inspection to prevent items from being overlooked. The four items mentioned above that are due for inspection every 2,000 miles, or 30 working days, could be added to the weekly inspection. If they are inspected during the weekly inspection, that would more than meet the inspection requirement of 2,000 miles or 30 working days.

Checklist Items—What to Look for

1. *Water and oil levels.* A check of the water and oil levels involves checking the radiator and the engine crankcase to ensure that the fluid levels recommended by the manufacturer are being maintained.
2. *Belts and radiator hoses.* In most cases, belts are located so that they can be seen and checked easily. This is true of belts on both the engines of conventional buses (in which the engine is located in the front of the vehicle) and of belts on the engines of pusher-type transit buses (in which the engine is located at the rear of the vehicle). The belts on the engines of midship-engine buses (in which the engine is located in the middle of the vehicle) cannot be checked quite as easily. To inspect the belts on a midship-engine bus, the driver must open both side doors of the engine compartment. On some forward-control coaches and Type 2 buses, inspection of the belts and hoses requires removal of the cover (or covers) of the engine compartment.

   Belts should be checked for the following defects:

   a. Broken belts
   b. Missing belts where two belts are required on one pulley
   c. Frayed or separated belts
   d. A belt that has turned over on its pulley
   e. Oil-soaked belts and pulleys

   Most bus engines are so constructed that the radiator hoses can be checked at the time the belts are examined. On midship-engine buses, not all the hoses are readily visible. Wherever the hoses are in plain view, they can be inspected. Hoses that the driver cannot see to inspect must be checked by a mechanic during each regular preventive maintenance service.

   Radiator hoses should be checked for the following defects:

   a. Leakage
   b. Cracks or signs of cracks developing
   c. Loose clamps

d. Signs that a hose is rubbing or scraping against another part
e. Oil-soaked hoses

3. *Starting the engine.* Before attempting to start the bus, the driver must ensure that the parking brake is set and that the transmission is in neutral (or in NEUTRAL or PARK if the bus has an automatic transmission). Then the engine should be started. On a vehicle equipped with a manual transmission, the clutch pedal should be held down while the engine is being started. With the clutch pedal depressed, the engine is disconnected from the transmission, and therefore the battery and starting motor will not have the added burden of turning the transmission gears. Also, depressing the clutch pedal during starting adds the safety factor of not starting the engine while it is in gear. If the vehicle has an automatic transmission, safety switches are provided that should prevent engine starting while the transmission is in gear.

   The oil-pressure gauge should be checked immediately after the engine is started. The gauge should show pressure within a few seconds. On vehicles equipped with a low oil-pressure indicator light, the light should come on when the ignition switch is turned on and should go out within a few seconds after the engine is started. In the case of any irregularity with the oil-pressure gauge or low-pressure indicator light, the engine should be stopped immediately and not restarted until a mechanic has determined that the system is in correct working order.

   If a vehicle has a hand throttle, the throttle should be set to maintain engine speed between 800 and 1,000 revolutions per minute (rpm). A cold engine should never be warmed up at more than 1,000 rpm.

4. *Ammeter and voltmeter.* The ammeter on vehicles equipped with ammeters should show a positive charge after the engine has been started. During the warmup period, the throttle should be set so that the ammeter shows a positive reading (or at least not a negative reading).

   On vehicles equipped with a voltmeter, the voltmeter should read within the range recommended by the vehicle manufacturer.

5. *Air and vacuum guages.* Vehicles equipped with air brakes have air-pressure gauges. These gauges should begin to show an increase in air pressure immediately after the engine is started. Vehicles equipped with hydraulic brakes and a vacuum booster have vacuum gauges, which should show vacuum buildup immediately after the engine is started.

6. *Fuel gauge.* The fuel gauge should indicate the level of fuel in the fuel tank or tanks.

7. *Driver's seat and seat belt.* Most drivers' seats can be adjusted upward, downward, forward, and backward. Some have backrest adjustments and seat-cushion adjustments. The various adjustments may be accomplished manually or by means of air pressure, depending on the type of seat. At least once each week, the driver or mechanic should adjust all parts of the seat in all possible positions to ensure that the seat mechanism is in correct working order.

   Each driver's seat must be equipped with a seat belt, and the seat belt must be adjustable. The seat belt should be checked carefully for cuts and fraying.

8. *Horns.* The horns must be checked for correct sound level. Regardless of type (air or electric), horns must be audible at a distance of at least 200 feet in all directions from the vehicle.

9. *Entrance door, steps, and emergency release.* The entrance door must be checked for proper operation and for the presence and proper condition of seals and gaskets around the door. The door inspection must include a check of the condition and operation of all lights and buzzers that are designed to function in connection with the door.

   Steps must be free from loose materials and defects that could cause persons to trip, slip, or fall. All lights used to illuminate step areas must be in correct working order.

   The emergency release on the entrance door must be examined for correct operation. The instructions for operating the emergency release must be posted and readable.

10. *Modesty panels and handrails.* Modesty panels and handrails must be securely fastened and free of cracks.

11. *Interior lights and step-well lights.* All interior lights and step-well lights must be in good working order. Lenses must be correctly installed and free of cracks.

12. *Heaters, defrosters, and fans.* The heaters, defrosters, and fans must be checked for correct operation. All heat ducts and all fans and blade guards must be examined to ensure that they are securely fastened.

13. *Windshield.* The windshield must be checked for cracks, chips, and discoloration that could interfere with the driver's vision. The windshield of a bus must be kept clean.

14. *Windshield wipers.* The windshield wiper motors (which may be vacuum, electric, or air driven) must be checked for correct operation. The wiper blades must be checked to ensure that they are in good condition.
15. *Mirrors.* All mirrors must be clean and free of cracks and discoloration. All outside and rear-view mirrors must be adjusted so that the driver can see at least 200 feet to the rear of the vehicle. (See item 58, Crossover mirror.)
16. *Fire extinguisher.* The fire extinguisher must be securely held in its bracket. It also must be installed in a manner that allows for easy removal. If the fire extinguisher is located where it is not readily visible (in a compartment, for example), a sign indicating the location of the extinguisher must be posted where it is clearly visible. Buses designated as wheelchair buses must have not less than two fire extinguishers. A service card showing the last date of service and the name of the person who performed the service must be attached to the fire extinguisher, and the seal on the extinguisher must be unbroken when the extinguisher is in service. The reading on the pressure guage should indicate that the extinguisher is fully charged. Also, an extinguisher of the dry-chemical type should be removed from its bracket once a week and shaken for several seconds to prevent the powder from compacting.
17. *Warning devices.* Each school bus and school pupil activity bus is required to have on board at least three reflector-type warning devices. These devices must be in good working condition, and they must be stored in a separate compartment or box that is securely fastened to the vehicle.
18. *First-aid kit.* The first-aid kit must be checked to ensure that it is the right size for the vehicle. The kit should be opened and its contents inspected to ensure that it contains the required number of units. The first-aid kit must be secured in a designated spot, and it must be easy to remove. If the kit is located out of sight, a legible sign indicating its location must be posted in clear view.
19. *Passenger seats.* Each passenger seat must be inspected to ensure that the seat frame is securely fastened to the floor and at all other required points. Seat frames must be free of cracks or breaks and must not be bent. Seat backs and cushions must be covered with padding and must be free of cuts. The padding material must be securely fastened to the cushions. Seat-rail padding, if padding is used, should be free of cuts and should be securely fastened to the seat backs.
20. *Floor covering.* The floor covering must be inspected for spots where it has been worn down to the underlying metal or wood and also for separations between the covering and the floor. Floors shall be kept clean.
21. *Windows.* All openable windows must be checked to make sure they open and close easily. The window latches must be checked for proper operation and secure attachment to the window frame. All window glass must be inspected for cleanliness, discoloration, and cracks.
22. *Emergency exit doors and windows.* Emergency exit doors and windows must be clearly marked, and instructions for opening doors or windows must be provided at or near each such emergency exit. All emergency exit doors and windows must be checked for correct operation by fully opening and closing them. Also, the condition of all gaskets around these doors and windows must be determined.
23. *Emergency exit door warning devices.* Every emergency exit door is equipped to actuate a light and a buzzer or other audible warning device when the door is open. All the warning devices must be checked to ensure that they are in correct working order.
24. *Temperature gauge and throttle setting.* If the vehicle has a temperature gauge, the engine temperature must be checked at this point in the procedure to ensure that it is within the range specified by the vehicle manufacturer.

    As an engine warms up, engine speed will increase without a change in throttle setting. Therefore, the setting of the hand throttle should be rechecked frequently to maintain an engine speed between 800 and 1,000 rpm (suggested engine-speed range for warm-up; however, recommendations of vehicle manufacturers may vary).
25. *Lights, switches, and indicators.* To check lights, all outside lights must be turned on. The headlights must be set on high beam and the directional signals set to signal for a left turn. The headlight high-beam indicator should be lit, and the left-turn directional signal indicator should be blinking

    The bus driver should go outside the bus to perform the series of checks in items 26 through 58. The driver should start at the front

and proceed systematically in a full circle around the bus.

26. *Front top identification lamps.* If the vehicle is equipped with front top identification lamps, these lights should be checked for correct working order and condition. The lenses must be bright amber, and they must not be faded. The lenses of all lights on the bus must be kept clean to maintain the required light output.
27. *Front red crossover lights.* On vehicles so equipped, the front red crossover lights should be checked for correct working order (with right and left lights flashing alternately 60 to 120 times per minute). The lenses of the front crossover lights must be bright red and must have no discoloration. If the crossover lights have shading hoods, the hoods must be securely fastened and must be positioned so that they do not interfere with the lights.
28. *Front school bus sign.* A front school bus sign shall be clean, free of discoloration, and easy to read. If the sign is bolted to the vehicle, it must be securely fastened.
29. *Headlights (high beam).* The high beams of both headlights must be burning with normal intensity and must have no discoloration. Also, the lenses must be clean.
30. *Fog lamps.* Fog lamps on vehicles so equipped must be in good working order.
31. *Left front turn signal light.* The left front turn signal light should be checked for correct working order and condition. The light must flash from 60 to 120 times per minute, and it must be visible from a distance of at least 500 feet to the front of the vehicle. The turn signal lens must be clean, and it must not be cracked or discolored. If the vehicle is equipped with directional indicator arrows, the arrows must be legible.
32. *Left mirror securement.* The left side mirror and its mounting brackets must be checked to ensure that the mirror is securely fastened to the body of the vehicle.
33. *Left front clearance light.* The left front clearance light must be checked for correct working order and mounting. The lens must be amber in color, and it must be clean, free of cracks, and free of discoloration.
34. *Left side supplemental turn signal light.* If the vehicle is equipped with a supplementary side-mounted turn signal light, the left side turn signal light must be checked to ensure that it is working correctly and is in good condition. The lens must be amber in color, and it must be clean, free of cracks, and free of discoloration. The light must flash from 60 to 120 times per minute.
35. *Left front tire, wheel, and lug nuts.* The tire must be checked for proper inflation, as recommended by the tire manufacturer. Recapped tires shall not be used on the front wheels. Tread depth must not be less than $^2/_{32}$ of an inch at any time. In checking the tires for defects, the person doing the inspection should be alert for cuts, bruises, and sidewall separations. Tires must have no cuts that are more than 1 inch long in any direction and deep enough to reach the body cords.

    The wheel must be free of cracks, and all lug nuts must be in place and must be tight.
36. *Left side body panels and reflectors.* All body panels shall be securely fastened to the body frame. Door panels shall be securely fastened to the body frame or to the hinges, and all door panels must have a positive locking device to prevent accidental opening. If the vehicle is required to have side reflectors, the reflectors must be properly maintained, including keeping the reflectors clean.
37. *Left center side marker light.* The left center side marker light must be checked to ensure that it is in correct working order and that the lens is not cracked or discolored. The light lens must be amber in color.
38. *Left side emergency door or exit.* The left side emergency door or exit must be checked by fully opening and closing it from the outside. The hinges and locking device must work freely, and the emergency door or exit must be clearly labeled.
39. *Left rear tires, wheels, lug nuts, and axle flange.* The left rear tire or tires must be checked for correct inflation pressure as recommended by the tire manufacturer. Tires must have no cuts that are more than 1 inch long in any direction and that are deep enough to reach the body cords. The person doing the inspection must be alert to cuts, bruises, and separations on tires. All tires must have not less than $^2/_{32}$ of an inch tread depth at any time. Recapped tires may be used on the rear wheels only.

    If dual tires are used, the tires must be matched so that they both will make level contact with the roadway at all times.

    All tires and wheels on the bus must be the same size. Wheels must be checked to ensure that no cracks exist, and all lug nuts must be

checked to ensure that they are correctly installed and tight.

The axle flange must be checked to ensure that all axle studs or cap screws are in place and that the axle gasket is not leaking oil or grease.

40. *Left rear clearance light.* The left rear clearance light must be checked for correct working order and mounting. The lens must be bright red, and it must be clean, free of cracks, and free from discoloration.
41. *Rear top identification lamps.* If the vehicle is equipped with rear top identification lamps, these lamps should be checked for correct working order and condition. The lenses must be bright red, and they must not be faded. The lenses of all lights on the bus must be kept clean to maintain normal light output.
42. *Rear red crossover lights.* On vehicles so equipped, the rear red crossover lights should be checked for correct working order (with right and left lights flashing alternately 60 to 120 times per minute). The lenses of the rear crossover lights must be bright red and have no discoloration. If the crossover lights have shading hoods, the hoods must be securely fastened and must be positioned so that they do not interfere with the lights.
43. *Rear school bus sign.* A rear school bus sign shall be clean, free of discoloration, and easy to read. If the sign is attached to the vehicle, it must be securely fastened.
44. *Rear emergency door or exit.* The emergency door or exit must be checked from the outside by fully opening and closing it. The bus driver or mechanic must make certain that the hinges and locking device work freely and that the emergency exit or door is clearly labeled.
45. *Left rear turn signal light.* The left rear turn signal light must be checked for correct working order and condition. The lens must be clean, and it must be free of cracks and discoloration. The light must flash from 60 to 120 times per minute, and it must be visible from a distance of at least 500 feet to the rear of the vehicle. If the bus was manufactured after July 1, 1970, the lenses in the rear turn signal lights must be amber.

    If the vehicle is equipped with directional indicator arrows, the arrows must be legible.
46. *Stop lights.* The stop lights must be checked to ensure that they are in correct working order. Various mechanical methods may be used to assist in performing this check, such as a brake pedal block. The lenses must be clean, free of cracks, and free of discoloration. Stop lights must be visible from a distance of at least 500 feet to the rear of the vehicle.
47. *Taillights and license-plate light.* The taillights must be checked to ensure that they are clean, free of cracks, free of discoloration, and in correct working order. Taillight lenses must be red. Taillights on vehicles manufactured before January 1, 1969, must be plainly visible from all distances within 500 feet to the rear of the vehicle. Taillights on vehicles manufactured on or after January 1, 1969, must be plainly visible from all distances within 1,000 feet to the rear of the vehicle.

    If the taillight is mounted directly over the license plate, the light shall serve to illuminate the license plate with a white light, so that the license plate is legible from a distance of at least 50 feet to the rear of the vehicle. If the taillight is not designed to illuminate the license plate, the vehicle must be equipped with a separate light to serve that purpose. The license-plate light must be checked for correct working order.
48. *Rear reflectors.* The rear reflectors must be checked to ensure that they are correctly mounted and clean. They must be red in color, and they must have no discoloration.
49. *"Stop When Red Lights Flash" sign.* The "Stop When Red Lights Flash" sign must be clean, legible, and not discolored.
50. *Right rear clearance light.* The right rear clearance light must be checked for correct working order and mounting. The lens must be red in color, and it must be clean, free of cracks, and free of discoloration.
51. *Right rear tires, wheels, lug nuts, and axle flange.* The right rear tire or tires must be checked for correct inflation pressure as recommended by the tire manufacturer. Tires must have no cuts that are more than 1 inch long in any direction and that are deep enough to reach the body cords. The driver or mechanic must be alert for cuts, bruises, and separations. All tires must have not less than $\frac{2}{32}$ inch tread depth at any time. Recapped tires may be used on the rear wheels only. If dual tires are used, the tires must be matched to ensure that they both make level contact with the roadway at all times.

    All tires and wheels used on the bus must be the same size. Wheels must be checked to ensure that they are not cracked.

    All the lug nuts must be checked to ensure that they are correctly installed and tight.

The axle flange must be checked to ensure that all the axle studs or cap screws are in place and that the axle gasket is not leaking oil or grease.

52. *Right side emergency door or exit.* The right side emergency door or exit must be checked by fully opening and closing it from the outside. The door hinges and locking device must be checked to ensure that they work freely and that the emergency door or exit is clearly labeled.
53. *Right side body panels and reflectors.* All body panels shall be securely fastened to the body frame. Door panels shall be securely fastened to the body frame or to the hinges. All door panels must have a positive locking device to prevent accidental opening.

    If the vehicle is required to have side reflectors, the reflectors must be correctly maintained, and correct maintenance includes keeping the reflectors clean.
54. *Right center side marker light.* The right center side marker light must be checked to ensure that it is in correct working order and that the lens is not cracked nor discolored. The light must be amber in color.
55. *Right front tire, wheel, lug nuts.* The tire must be checked for correct inflation as recommended by the tire manufacturer. No recapped tires shall be used on the front wheels. Tire tread depth must not be less than $^{2}/_{32}$ inch at any time. In checking the tires for defects, the driver or mechanic must be alert for cuts, bruises, and sidewall separations. Tires must have no cuts that are more than 1 inch long in any direction and deep enough to reach the body cords.

    The wheel must be free of cracks, and all the lug nuts must be in place and tight.
56. *Right front clearance light.* The right front clearance light must be checked for correct working order and mounting. The lens must be amber in color, and it must be free of cracks and discoloration.
57. *Right mirror securement.* The right side mirror and its mounting brackets must be checked to ensure that the mirror is securely fastened to the body of the vehicle.
58. *Crossover mirror.* The mirror may be mounted on either the right front or the left front of the vehicle. The mirror must be inspected for cracks and discoloration and to ensure that it is securely attached to the vehicle. The crossover mirror must be clean, and it must be adjusted so that the driver, when seated, can see the area directly in front of the vehicle.

    After checking the crossover mirror, the driver should reenter the bus and if necessary reset the hand throttle to maintain the correct engine idle speed (between 800 and 1,000 rpm). Then he or she should move the turn signal control to the right, set the headlight dimmer switch on low beam, and remove any mechanical aids used for the stop-light check.
59. *Temperature gauge (recheck).* The temperature gauge should be rechecked to ensure that the engine temperature is within the range specified by the vehicle manufacturer.
60. *Indicator lights.* The headlight high-beam indicator should be off, and the right-turn signal indicator should be flashing. The driver should then go outside the bus to check items 61 through 64.
61. *Headlights (low beam).* The low beams of both headlights must be burning with normal intensity, and the headlight lenses must have no discoloration.
62. *Right front turn signal.* The right front directional light must be checked for correct working order and condition. The light must flash from 60 to 120 times per minute, and it must be visible from a distance of at least 500 feet to the front of the vehicle. The lens must be clean, and it must have no cracks or discoloration. If the vehicle is equipped with directional indicator arrows, the arrows must be clearly legible.
63. *Right side supplemental turn signal.* If the vehicle is equipped with a supplemental turn signal, it should be checked for correct working order and condition. The lens must be amber in color, and it must be clean and free of cracks and discoloration. The light must flash from 60 to 120 times per minute.
64. *Right rear turn signal light.* The right rear turn signal light must be checked for correct working order. The lens must be clean, and it must have no cracks or discoloration. The light must flash from 60 to 120 times per minute, and it must be visible from a distance of at least 500 feet to the rear of the vehicle. If the vehicle is equipped with directional indicator arrows, the arrows must be clearly legible.

    The driver should reenter the bus to check the remaining items on the checklist.
65. *Air-pressure gauges.* All air-pressure gauges (service-brake gauge or gauges and emergency-tank gauge, if so equipped) must be checked to

ensure that air pressure has been built up to maximum. The gauge should be tapped occasionally while the pressure is being checked to ensure that friction or lag in the gauge mechanism is not causing a false reading.

66. *Governor cut-in and cut-out pressure.* With the engine running, the service-brake foot treadle should be pumped slowly to reduce the air pressure in the brake system. Pumping the treadle should be continued until the air governor cuts in, at which point the air pressure will begin to build up. The gauge reading at the cut-in point should be noted and again at the point when the air governor cuts out (when maximum pressure has been reached). The low cut-in pressure shall not be less than 85 psi, and the high cut-out pressure shall not be more than 130 psi.

    In vehicles that require additional air pressure for special systems (for example, "air-ride" systems), regulations permit the governor cut-out pressure to be 150 psi. However, in such vehicles the air pressure delivered to the braking system must not exceed 130 psi.

67. *Static pressure loss.* To check the air-brake system for static pressure loss, the driver or mechanic must first allow the air pressure to build up to the maximum. Then the engine must be shut off and the following test performed, without the service brake being applied. However, the hand parking brake or the spring brake may be set during this test. For not less than one minute, the air gauge or gauges must be observed for loss of air pressure, including the emergency-tank gauge if the bus is so equipped. Any static pressure loss must not exceed 2 psi per minute. Operating a vehicle that does not meet this air pressure test is a violation of Vehicle Code Section 26453 and Title 13, Section 1215 (h) (1).

68. *Pressure loss with brakes applied.* To test for air pressure loss with the service brakes applied, the air pressure should be allowed to build up to maximum; then the engine should be shut off and the spring brake released. Next, the service-brake foot treadle should be depressed and held in the fully applied position for one minute. After the initial drop due to brake application, the loss in air pressure as registered on the gauge must not exceed 3 psi per minute.

    Operating a vehicle that does not meet this test is a violation of Vehicle Code Section 26453 and Title 13, Section 1215 (h) (2).

69. *Low-pressure warning device.* The low-pressure warning device must be checked. The air pressure must be reduced to 55 psi or slightly less by repeatedly depressing the service-brake treadle. Then the engine should be restarted. The low-pressure warning device should signal that the air pressure is too low.

    Warning devices must be readily visible or audible from the driver's seat. A gauge or light alone does not satisfy the low-pressure warning-device requirement for a school bus. A school bus with air or vacuum power brakes must include a buzzer or other audible warning signal. Most school buses have both a light and a buzzer to warn of low air pressure. In such vehicles, both warning devices must be checked for correct working order.

    If the vehicle is equipped with a mechanical low-pressure warning device, which is required on school buses manufactured prior to April 1, 1977, such device shall be in correct working order.

70. *Emergency stopping system.* Before beginning the check of the emergency stopping system, the air pressure must be built up to maximum. The readings of the air-pressure gauges for the service-brake system and the emergency stopping system must be noted if the tank is equipped with a gauge (the "third tank"). Both gauges should read the same. The engine should be stopped and with test sequence (a) or (b) continued, depending on the date of manufacture of the bus.

    a. Buses manufactured before January 1, 1968:

        First, the air pressure in the service-brake system must be reduced by repeated application of the service-brake treadle until the spring brakes seat themselves. This should occur when the air-pressure gauge for the service-brake system has dropped to 45 psi or lower but to not less than 20 psi. If the spring brakes do not set within this pressure range, the vehicle must not be driven.

        The person performing the check should be able to hear the spring brakes seat themselves and at the same time see the spring-brake control valve on the instrument panel seat itself. The air-pressure gauge (if the system is equipped with a gauge) for the emergency stopping system should still read the same as when the test was started. If this gauge shows a drop in

pressure, the check valve between the emergency stopping system and the service-brake system is defective, and it must be repaired; a mechanic should be notified.

Next, the spring-brake control valve should be pulled out and held as if to release the spring brakes, and the emergency stopping system air-pressure gauge should be observed. The gauge should not indicate a drop in pressure. Now the spring-brake control valve should be released. It should reseat itself in the spring-brake-applied position.

Finally, the spring brakes should be released by pushing in on the emergency-brake release valve and pulling out on the spring-brake control valve. The emergency stopping system air-pressure gauge should now indicate a drop in pressure.

b. Buses manufactured after January 1, 1968:

Modulated emergency brake systems are found on buses manufactured on or after January 1, 1968. On buses with these modulated emergency brake systems, the emergency brakes can be applied, released, and reapplied by the driver by means of a modulating hand control. Some systems of this type have spring-applied actuators (spring brakes). Others have air-applied actuators. However, the checkout procedure is essentially the same, regardless of the type of actuator used.

With air pressure at maximum and engine stopped, the air pressure should be reduced by repeated application of the brake treadle until the service-brake air pressure gauge indicates between 40 and 20 psi. If the school bus is equipped with an emergency tank, the gauge should still indicate maximum air pressure.

In vehicles with the modulated type of emergency stopping system, the emergency brakes *will not* automatically apply themselves. Therefore, using the modulating hand-control valve, the driver should apply and release the emergency brakes at least once and observe the reading of the emergency-tank air-pressure gauge, if the school bus is so equipped. Most emergency stopping systems have sufficient reserve capacity for several applications and releases. If the modulated emergency stopping system is the spring-brake type, the emergency-tank gauge should show a drop when the spring brakes are released. If the modulated emergency stopping system is the air-applied type (also called a double-diaphragm system), the emergency-tank gauge (if the school bus is so equipped) should show a pressure loss when the brakes are applied.

71. *Air-brake adjustment.* The only direct way to determine whether an air-brake system requires adjustment is to measure slack-adjuster travel. This is not a practical test for the driver to perform, but it should be performed every 30 days or 2,000 miles by maintenance personnel. However, the driver can obtain an indication of the need for air-brake adjustment by testing the brakes for their stopping ability.

A Type I bus, at any time and under all conditions of pupil loading, shall perform as follows when tested from a speed of 20 miles per hour:

a. Manufacturer's gross vehicle weight rating of 10,000 pounds and under: maximum stopping distance is 25 feet.
b. Manufacturer's gross vehicle weight rating of more than 10,000 pounds: maximum stopping distance is 35 feet.

If the vehicle pulls to the right or to the left during the stopping-distance test, this could indicate that the brake on one or the other of the front wheels is out of adjustment. This test or a mechanic's check of slack-adjuster travel should be conducted at least every 30 days or 2,000 miles.

Caution: Extreme care must be taken when brakes are being road tested for stopping distance. A location should be chosen that will be free from interference by other traffic during the test. Ideally, such tests should be conducted in a controlled area, not on a highway, and without sliding the wheels.

72. *Parking-brake test.* The parking brake should be tested with the engine running at fast idle. The parking brake should be set and the test conducted as follows:

If the vehicle has a standard transmission, the transmission should be placed in second gear; then the clutch should be let part way out so as to put a slight strain on the parking brake. If the parking brake is functioning correctly, it should prevent the vehicle from moving.

If the vehicle has an automatic transmission, the selector should be set in "drive" position; then enough throttle applied to place

a slight strain on the parking brake. The parking brake should prevent the vehicle from moving.

Regardless of the type of transmission the vehicle has, the test of the parking brake should be kept brief to avoid damaging the brake, transmission, or other components of the vehicle. The parking brake must be capable of holding the vehicle stationary on any grade on which the vehicle is operated, under all conditions of loading and on a surface that is free of snow, ice, or loose material.

73. *Antilock system checkout.* If the vehicle is equipped with the antilock system, the antilock failure-warning signal lamp must be visible to the driver. If the antilock system has an audible warning device, the device must operate for at least 10 seconds while the visible signal is on. The warning device may indicate a total or a partial failure of the antilock system.

The following test is for testing the electrical components of the antilock system only: The ignition switch should be turned on and the antilock failure-warning signal observed. If the signal lamp comes on for a few seconds and then goes off and remains off, the antilock system is working correctly. If the lamp stays on or comes on and then goes off for about a second and again comes on and stays on for more than a minute, this is evidence of an electrical failure in one or all of the axle antilock devices.

In every vehicle equipped with the antilock system, a placard gives step-by-step instructions for checkout of the system and tells what to do if an electrical failure should occur while the vehicle is being operated.

74. *Split-axle protection test.* Most vehicles equipped with the antilock system are also equipped with a split-axle protection system. Briefly, this means that the air-brake system has a separate air tank for brakes on each of the vehicle axles. If a brake failure or a large air loss occurs on one axle, the brakes on the remaining axle or axles will still work correctly with an adequate supply of compressed air.

An air-brake system equipped with split-axle protection is checked out in the same way as any other air-brake system, except that two service-brake air-pressure gauges are used (or one gauge is used with two different-colored needles, usually red and green). Both gauges or needles should show the same drop or the same rise in air pressure during checkout of the system. If one gauge or needle shows a greater drop than the other and the air brakes are known to be in correct adjustment, an air leak is indicated and must be corrected.

75. *Vacuum over hydraulic brake system.* If the vehicle is equipped with a vacuum over hydraulic brake system, the brakes should be checked as follows:

a. The engine should be started and operated at idle speed until the vacuum gauge shows at least 15 inches of mercury. The engine should be shut off and the gauge observed for any indication of a drop in vacuum. Any drop should not exceed 3 inches of mercury per minute.

b. The vacuum reserve should be decreased to 6 inches of mercury, as indicated on the vacuum gauge, by repeatedly applying the brake pedal. The ignition switch should be turned on; the low vacuum warning device should be operating. The engine should be restarted; the warning device should shut off before the vacuum level exceeds 10 inches of mercury. The vacuum should be allowed to increase to the maximum; then the engine should be shut off.

c. The brakes should be applied and held, while the gauge is observed for any indication of loss of vacuum. The maximum acceptable loss is 3 inches of mercury per minute.

d. With the engine still off, the brake should be applied and released several times to deplete the vacuum reserve. Then, the brake pedal should be depressed with moderate force until it stops. The pedal should be held in that position and the engine started. If the pedal tends to fall away under foot pressure, the vacuum assist is working correctly.

e. The engine should be shut off and the brakes applied and released several times to deplete the vacuum reserve. Then, the brake pedal should be depressed and the distance it travels before the brake pedal becomes hard to depress should be noted. This should occur at a point about halfway between the fully released position of the pedal and the floor. If the pedal travels more than 60 percent of the distance from the fully released position to the floor, the brake adjustment should be checked.

f. With the engine still off, a test for fluid leaks in the system should be conducted by holding the brake pedal down hard for one minute. Any further downward movement

of the pedal after the brake has been applied indicates an internal or external leak in the hydraulic system.

g. The engine should be restarted, the brakes released, and the vehicle slowly moved forward and backward a few feet to test for brake-shoe drag. Dragging brake shoes may make a squealing or rubbing noise, or the vehicle may be difficult to move.

76. *California Highway Patrol (CHP) Vehicle Inspection Approval Certificate.* The California Highway Patrol (CHP) inspection card must be installed, as required, after it has been properly signed by an inspector within the previous 13 months.
77. *Radios and loudspeakers.* If a vehicle is equipped with a two-way radio and/or public-address loudspeakers, these items should be checked for correct working order. Two-way radios should be tested in accordance with local testing procedures.
78. *Brake test.* It is recommended that the driver of a school bus or school pupil activity bus conduct a test of the braking system by making two complete stops before permitting students to board the bus for the purpose of being transported.

Every vehicle equipped with air brakes must also have an emergency stopping sytem capable of stopping the vehicle within the following distances from a speed of 20 miles per hour:

a. Single vehicle: within 90 feet
b. Single vehicle with three or more axles: within 120 feet

Importance of the Daily and Weekly Inspections

The daily and weekly inspections by the driver are the most important parts of a safe operation. The driver is the first person to recognize a problem when one develops, and the driver's written report enables the mechanic to identify and correct the problem. The driver is thus the key to this part of the school bus driver training program, and he or she should therefore be well trained. As was noted earlier in this chapter, the suggested daily checklist was developed as a driver-training tool. The safety of all passengers depends on the inspections being done correctly.

Chapter III
Preventive Maintenance Program

Preventive maintenance plays a vital part in the safety and efficiency of a transportation program. Correctly scheduled maintenance provides maximum dependability, maximum life, and peak performance for the vehicles and safety for all who use them—the drivers as well as the passengers.

Preventive maintenance involves correct scheduling of lubrication, oil changes, fluid-level checks, and other regular service operations, plus making minor repairs and adjustments which, if neglected, might lead to major mechanical problems requiring extensive and expensive repairs.

The foremost objective of a planned preventive maintenance program is keeping each vehicle in safe operating condition. Other objectives are preventing road failures, maintaining the vehicle in efficient operating condition, and keeping maintenance costs minimal by prolonging component life and thus reducing the need for major repairs or overhaul.

Scheduled servicing and detailed periodic inspections should be carried out for each bus in accordance with the recommendations in the bus manufacturer's service manual, making suitable allowances for local operating conditions. The inspection and service intervals will depend to a great extent on the use that the vehicle receives. However, service intervals are commonly set up on the basis of vehicle mileage, service-due dates, and engine hours of operation.

Basic Requirements for a Preventive Maintenance Program

This guide contains suggestions and sample forms that will help the operator set up a vehicle inspection and preventive maintenance program that meets state requirements and satisfies local needs. The suggested preventive maintenance program detailed in this chapter was planned to have broad application and be as flexible as possible, but obviously no single program can be written that will fit every type of operation and every type of vehicle.

The following program is a suggested one that is being used by many operators with good results:

1. A written schedule should be maintained. This schedule may be a service-control chart or board on which each vehicle is listed and identified, along with each type of service and when due. A positive method should be used to show when the next service is due either on a control chart or a control board. (See the sample preventive maintenance control chart, Fig. III-1.)
2. A complete list should be developed of checks and service operations to be performed, including a positive means of indicating that each item has been performed. The use of checklists like the ones shown in this chapter is recommended.
3. A sticker or other reminder of "NEXT SERVICE DUE," by mileage or date, should be placed within each vehicle in view of the driver. (See Fig. III-2.)
4. A systematic inspection and maintenance record should be maintained for each bus.

A Suggested Preventive Maintenance Program

The suggested preventive maintenance program in this chapter is based on the "alphabet" concept, in which each item that requires periodic inspection and service on a vehicle is listed on an "A," "B," "C," or "D" preventive maintenance checklist. The category of an item depends upon how often the item is to be checked. Sample "A," "B," "C," and "D" checklists are presented in this chapter. (See Figs. III-3 through III-6.) To establish an "alphabet" preventive maintenance system, the operator should develop checklist forms similar to those samples referred to. These checklist forms should indicate item by item and in correct order what is to be done by the service personnel. The sample checklists are suggested forms. They may require modification and expansion to fit specific situations and vehicles. The person performing the service should check off each item in the checklist as the item is accomplished; then he or she should sign and date the checklist; and finally he or she should place it in a folder or binder that has been set up for that vehicle. The completed checklists then provide a preventive maintenance record for

PREVENTIVE MAINTENANCE CONTROL CHART

Mileage (500) intervals →

Bus number	500	1,000	1,500	2,000	2,500	3,000	3,500	4,000	4,500	5,000	5,500	6,000	6,500	7,000	7,500	8,000	8,500	9,000	9,500
1				A				A				B				A			
2				A				A				B				A			
3			A				A				B				A				A
4				A				A				B				A			
5		A		A		A		A		A		B		A		A		A	
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			
31																			
32																			
33																			
34																			
35																			

SAMPLE

Fig. III-1. Sample preventive maintenance control chart

PREVENTIVE MAINTENANCE CONTROL CHART (Continued)

10,000	10,500	11,000	11,500	12,000	12,500	13,000	13,500	14,000	14,500	15,000	15,500	16,000	16,500	17,000	17,500	18,000	18,500	19,000	19,500	20,000
A				B				A				A				C				A
A				B				A				A				C				A
			B				A				A				C				A	
A				B				A				A				C				A
A		A		B		A		A		A		A		A		C		A		A

SAMPLE

Extend chart as required

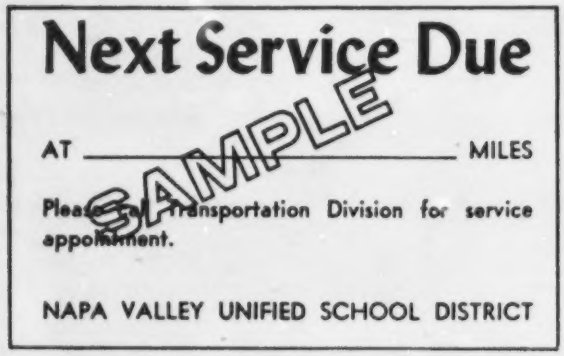

Fig. III-2. Sample "Next Service Due" sticker

the vehicle. Another method is to use the checklist as a guide; and when the service on a vehicle is completed, the person performing the service should enter the date, mileage, type of service performed, and his or her name on a card maintained for that vehicle in a card-file system.

The "A" Service Check

The "A" service check contains the smallest number of items and is performed at the most frequent intervals. Each item on the checklist should be listed in the order in which the service on the item would normally be performed. Completing the checks in order will give the mechanic the most efficient course to follow in performing the checks, and it will also ensure that no item is overlooked.

The "B" Service Check

The "B" service check is performed at somewhat longer intervals than the "A" service check. It normally includes all of the items in the "A" service check, in addition to such items as oil and filter changes.

The "C" Service Check

The "C" service check includes all of the items in the "A" and "B" service checks, plus items that would normally be inspected or serviced only every six months (usually at the middle of the school year), or at the mileage interval recommended by the equipment manufacturer.

The "D" Service Check

The "D" check includes all of the "A," "B," and "C" checks, plus additional items that would normally be inspected or serviced only once a year (usually during the summer months) or at high mileage, as recommended by the equipment manufacturer.

"Next Service Due" Sticker

So that the driver of a vehicle will know when the next scheduled service is due, some means should be employed for recording and displaying service information within the vehicle. The simplest method is to apply a service sticker in a conspicuous place in the driver's compartment. (See Fig. III-2.)

When the vehicle receives an "A" service, the person performing the service indicates on the sticker the mileage at which the next service is due. When the mileage on the vehicle odometer matches the mileage on the sticker, the driver fills out a Vehicle Condition Report and submits it. This procedure is especially helpful for ensuring that scheduled service is being reported and carried out.

Preventive Maintenance Control Chart

A control chart like the one shown in this chapter will indicate to the maintenance personnel which buses are due for service and how often each bus is to have each type of service. (See Fig. III-1.) The mileages across the top of the sample chart are set up in 500-mile increments. These are mileage intervals, not actual speedometer readings. The vehicle identification numbers are listed down the left side of the chart. Such a chart is often made in the form of a control board that may be located in the maintenance shop or the lube room. Colored pins or pegs can be used to indicate on the board when each type of service is due for each vehicle. For example, a red pin could indicate an "A" service check, green "B," yellow "C," and so forth. Many other methods can be used.

One of the major values of a control chart like this is that it simplifies any needed rescheduling of service operations. If a vehicle has been placed on a certain preventive-maintenance schedule and the service intervals are found to be too long for the vehicle, the colored pins can simply be moved back. The service intervals for one or two vehicles or for the entire fleet can easily be rescheduled this way on the chart.

The service personnel must be kept informed about which vehicle is coming in for service and when, and this is accomplished not only by the control chart but also by the "Next Service Due" notation that is marked in the vehicle. The driver should note in the weekly condition report the

PREVENTIVE MAINTENANCE RECORD
"A" CHECK

√ = Checked
X = Serviced

Vehicle No. _____
License No. _____
Mileage _____

	Service Check
	1. Check tires:
	a. Air pressure
	b. Objects in tread
	c. Tread wear
	d. Lug nuts
	e. Dual match
	2. Check steering box and reservoirs:
	a. Oil level
	b. Mounting bracket (no looseness)
	c. Power-steering reservoir (fluid level)
	3. Service air cleaner:
	a. Dry type—clean and inspect with light
	b. Wet type—clean and fill with oil
	4. Clean engine breathers.
	5. Check air compressor:
	a. Filter if so equipped
	b. Oil level
	c. Mounting bracket (no looseness)
	6. Check batteries:
	a. Water level
	b. Terminals (tight, no corrosion)
	c. Proper securement
	7. Check radiator (coolant level and leaks).
	8. Check shutter operation.
	9. Check brake master cylinder (fluid level and leaks).
	10. Check hydraulic clutch:
	a. Fluid level
	b. Slave cylinder for leaks
	11. Check windshield washer (fluid level and operation).
	12. Grease all fittings and check engine oil.
	13. Check transmission (oil/fluid level and leaks).
	14. Check differential (oil level and leaks).
	15. Drain all air tanks in rotation:
	a. Check operation of all check valves
	b. Check spring-brake operation
	c. Check split axle protection shuttle valve

	Safety Check
	1. Check brake adjustment (all wheels).
	2. Check belts (tight, not split or frayed).
	3. Check tie-rod ends and drag link (no looseness).
	4. Check power-steering pump, hoses, lines, and cylinders for leaks.
	5. Check air hoses (not worn or cracked).
	6. Check exhaust system for leaks.
	7. Check leaf springs or coil springs (not broken or loose).
	8. Check shock absorbers (not loose or leaking).
	9. Check universal joints (no looseness).
	10. Check drive shaft guard securement.
	11. Check all mirrors and windows.
	12. Check clutch adjustment.
	13. Check parking-brake adjustment.
	14. Check coolant hoses and clamps.
	15. Check axle seals for leaks.
	16. Check fuel tanks and brackets (no leaks or cracks; proper securement).
	17. Check electrical system (proper operation).
	18. Check fire extinguishers (charged and tagged).
	19. Check first-aid kit (correct size and contents).
	20. Check emergency reflectors (3).
	21. Check emergency exits:
	a. Proper operation of exits
	b. Warning devices
	c. Latches and hinges
	22. Check all engine warning devices (start engine).
	23. Check all gauges for proper operation:
	a. Tachometer
	b. Speedometer
	24. Check all lights.
	25. Check filters and drain plugs (no leaks).
	26. Check 121 computer test light.
	27. Change "Next Service Due" sticker.

SAMPLE

Serviced By _____

Date _____

Fig. III-3. Sample preventive maintenance record ("A" check)

PREVENTIVE MAINTENANCE RECORD
"B" CHECK
(Includes all of "A" check)

✓ = Checked
X = Serviced

Vehicle No. _____
License No. _____
Mileage _____

	1. Perform complete "A" check.
	2. Change engine oil.
	3. Change oil filter(s).
	4. Check fuel filters (proper operation, no leaks).
	5. Check coolant filter (proper operation, no leaks).
	6. Check freeze plugs (no leaks).
	7. Check motor mounts (not loose, cracked or broken).
	8. Check radiator pressure cap (proper operation).
	9. Check oil pan (all bolts tight, no leaks).
	10. Check valve covers (all bolts tight, no leaks).

	11.
	12.
	13.
	14.
	15.
	16.
	17.
	18.
	19.
	20.

SAMPLE

Serviced by _____

Date _____

Fig. III-4. Sample preventive maintenance record ("B" check)

PREVENTIVE MAINTENANCE RECORD
"C" CHECK
(Includes all of "A" and "B" checks)

✓ = Checked
X = Serviced

Vehicle No. _____
License No. _____
Mileage _____

	1. Perform complete "A" and "B" checks.
	2. Check complete steering assembly for defects.
	3. Check springs, shackles, and hangers.
	4. Check kingpins and bushings for wear.
	5. Change coolant filter.
	6. Check and change antifreeze as needed.
	7. Change fuel filters.
	8. Drain water from fuel tanks.
	9. Check all seats and repair as necessary.
	10. Check driver's seat for proper operation.
	11. Lube engine-shutdown system (if so equipped).

	12.
	13.
	14.
	15.
	16.
	17.
	18.
	19.
	20.

SAMPLE

Serviced by _____

Date _____

Fig. III-5. Sample preventive maintenance record ("C" check)

PREVENTIVE MAINTENANCE RECORD
"D" CHECK
(Includes all of "A," "B," and "C" checks)

✓ = Checked
X = Serviced

Vehicle No. _____
License No. _____
Mileage _____

	1. Perform complete "A," "B," and "C" checks.
	2. Steam clean.
	3. Check wheel bearings; clean and repack if needed.
	4. Check brake linings, drums, and working parts.
	5. Remove and inspect brake chambers, springs, diaphragms, related parts.
	6. Check wheel seals and gaskets.
	7. Check wheel spindles for cracks and other defects.
	8. Inspect emergency-brake lining and mechanism.
	9. Change transmission oil (or fluid if applicable).
	10. Change differential oil.
	11. Change steering-box oil.
	12. Check starter and overhaul as needed.
	13. Check generator/alternator and overhaul as needed.
	14. Check thermostats, heaters, and defrosters.
	15. Check cooling system and repair as needed.
	16. Repair body damage and paint.
	17. Check air-operated door controls and repair as needed.
	18. Check windows, frames, and latches.
	19. Replace front door seals as needed.
	20. Tighten all body and chassis bolts and screws.
	21. Check and lubricate speedometer and tachometer cables.

	22. Check headlamp adjustment.
	23. Check voltage regulator and charging rate.
	24. Inspect wiring and connections.
	25. Adjust valves and injectors.
	26. Tighten cylinder-head bolts.
	27. Tighten manifolds; check for leaks.
	28. Perform tune-up as needed.
	29. Overhaul engine as needed.
	30. Check transmission for smooth shifting and quiet operation.
	31. Check differential for quiet operation.
	32. Inspect differential pinion for play.
	33. Inspect universal joints and flanges; tighten bolts.
	34. Check propeller-shaft center bearing.
	35. Check radius rods; adjust as needed.
	36. Check all wheels for trueness.
	37. Check accuracy of pressure gages.
	38.
	39.
	40.

Serviced by _____

Date _____

SAMPLE

Fig. III-6. Sample preventive maintenance record ("D" check)

mileage or date when the next service is due. Such a double-check system is necessary to ensure that the required service for the vehicle will not be overlooked.

If all the vehicles are stored at the same location where the normal service work is performed, control of service operations is not too much of a problem. Once every three or four days, the service personnel can check the odometer reading in each vehicle against the "Next Service Due" sticker to confirm the mileage at which a service will be coming due. If the vehicles are kept elsewhere, this would be difficult.

The records required for controlling and evaluating a preventive maintenance program will be explained in the next chapter.

Chapter IV
Recordkeeping

Basic Records

A systematic method of recordkeeping is an essential part of every preventive maintenance program. Records must be kept carefully to meet legal requirements for accountability and also to evaluate the work being performed. Records are also maintained for several purposes that do not relate directly to the maintenance program—cost control, for example. A preventive-maintenance record-keeping system should be tailored to meet the requirements of the individual transportation system, but it should not be overly complex. Every record should be justified by the use made of it. No record should be kept that does not contribute directly to the safety and efficient management of the transportation system.

The following basic types of records are necessary for conducting a systematic preventive-maintenance program:

1. Vehicle inventory list
2. Daily pretrip inspection checklist
3. Vehicle condition report
4. Weekly vehicle inspection report form
5. Preventive maintenance schedule control chart or control board
6. "A" service checklist
7. "B" service checklist
8. "C" service checklist
9. "D" service checklist
10. Vehicle service sticker indicating "Next Service Due"
11. Shop repair work order
12. Copies of all CHP inspection forms

Vehicle Inventory List

Every fleet operator should maintain an up to date vehicle inventory list. Such an equipment list would normally include the following headings for identifying each vehicle in the fleet: bus number, make, model, year, student capacity, and license number. The format of the list may be expanded to include other items of information required by the operator. (See sample vehicle inventory list, Fig. IV-1.)

VEHICLE INVENTORY LIST

Bus number	License number	Chassis make	Body make	Model	Vehicle year	Student capacity	Other

SAMPLE

Fig. IV-1. Sample vehicle inventory list

Daily Pretrip Inspection Checklist

The California Administrative Code requires that each school bus or school pupil activity bus (SPAB) shall be inspected by the driver daily, before use, to ascertain that it is in safe condition, that it is equipped as required by all provisions of law, and that all equipment is in good working condition. To ensure that all drivers understand how to complete the required daily vehicle inspections, a step-by-step checklist that covers every item in the checkout procedure should be prepared. A multipurpose form may be developed to fit all the buses in the fleet; or several different forms may be used, each tailored to fit a specific type of vehicle (for example, Type I, Type II, or wheelchair Type) bus.

The daily bus inspection list is a sample multipurpose form. (See Fig. II-1.) Like all the other forms in this manual, it may be in the form presented in this guide, or it may be modified to fit individual needs.

Vehicle Condition Report

If during a daily inspection, weekly inspection, or at any other time a defect or malfunction is discovered in the vehicle, the driver must prepare a written report describing the problem in sufficient detail that it can be further inspected by a mechanic. The report must be filed even if the driver is doubtful about the condition of a part or system. A sample Vehicle Condition Report form is included in Chapter II of this guide. (See Fig. II-2.) After reviewing the Vehicle Condition Report form and making the repairs needed to correct the deficiencies, the mechanic should initial and date the form to indicate that the work has been completed. The Vehicle Condition Report could be made out in duplicate. One copy could be attached to a shop work order or filed in a folder or binder that is kept for the vehicle. The other copy could be returned to the driver or left in the vehicle so that the driver will know that the defects have been corrected.

The purpose of a Vehicle Condition Report form is to establish a line of written communication between the driver and the person who is responsible for maintaining the vehicle. All such reports must be retained by the operator for at least one month, and they must be kept readily available for inspection by the California Highway Patrol.

Weekly Vehicle Inspection Report Form

The weekly vehicle inspection form is designed to accomplish the following:

1. To provide a checklist for items to be included during the inspection
2. To be used as a training guide for the persons conducting the inspection
3. To be used by the California Highway Patrol as an evaluation of the inspection being performed

It would be helpful when this form is designed to list items in the correct inspection order so as to save inspection time.

Preventive Maintenance Schedule (Control Chart or Control Board)

Some positive method of scheduling should be used to ensure that preventive maintenance is being performed at regular intervals on every vehicle in the fleet. Use of a preventive maintenance schedule sheet or control chart is recommended. (See Fig. III-1 in this guide.) The sample control chart in Fig. III-1 has been set up on a mileage basis, but running-time intervals or service-due dates may be preferable for some operations. Some fleet operators use a preventive maintenance control board to meet the scheduling requirement.

Without some type of monitoring like that provided by a control chart or a control board, a preventive maintenance system can easily deteriorate to the point where it no longer accomplishes its purpose. Missed maintenance checks can drag a system into "crisis" maintenance, which cannot take the place of planned, programmed maintenance.

A control chart, control board, or some other positive means of scheduling the preventive maintenance should be available for inspection by officials of the California Highway Patrol

"Alphabet" Checklists

Periodic preventive maintenance checks will be performed with greater consistency and will take less time if "alphabet" checklists like the samples in Chapter III of this guide are used. The completed checklists for each vehicle should be kept in a folder for that vehicle, where they will become part of the vehicle service record. The checklists need not be filed if they are used only as a preventive maintenance guide, as described in Chapter III. However, some type of record must be kept to show that the scheduled "A," "B," "C," and "D" checks have been made. A cardfile system is often used for this purpose. A sample preventive maintenance control card is shown in this chapter. (See Fig. IV-2.) The completed, signed, and dated checklists—or the equivalent information on a control card, if the control card method is used—

Mileage	Vehicle No._____ License No._____ Services A	B	C	D			Job performed Date	By	Next service due

SAMPLE

Fig. IV-2. Sample preventive maintenance control card

must be kept on file and made available for the inspection of CHP officials.

"Next Service Due" Sticker

Maintaining an up-to-date "Next Service Due" sticker in a prominent place in the driver's compartment is a suggested part of recordkeeping. The mechanic who performs the "alphabet" preventive maintenance checks normally should change the sticker notation upon completion of the "A" check.

Shop Repair Work Order

Every operator is required to maintain complete and accurate records of all repair work performed on every school bus or school pupil activity bus subject to the operator's control. Whenever any repair work is performed on a bus, the mechanic performing the work should complete a shop repair work order, which then becomes a part of the required repair history for the vehicle. The work order is normally a multicopy form. (See Fig. IV-3, a sample work order.) The hard copy is kept in a binder or folder as a permanent record for the vehicle. The other copy or copies would normally be forwarded to the accounting office.

Many other methods may be used to provide a record of the repair work performed on a vehicle. For example, some operators keep a separate vehicle-repair log book for each school bus in the fleet. Whatever method is used, the record of repairs made to a vehicle must include at least the vehicle number, or other positive identification; the date on which the repairs were made and by whom they were made; a description of the work performed; and an itemized list of the parts used.

The written work order is intended to provide a record of shop repairs made to the vehicle, and it is therefore usually considered apart from the records normally kept for the preventive maintenance program. However, a work order could be designed to serve both functions—repair and preventive maintenance.

The shop repair records for each vehicle should be kept for as long as the vehicle is in the operator's control, and they must be available to officials of the California Highway Patrol.

If service or repair for a vehicle is "farmed out," instead of being performed by the operator, the operator should supply the vendor with all appropriate and necessary forms, such as service checklists and shop-repair work orders. The vendor doing the work must complete the necessary forms and return them to the operator, who must file and retain them.

California Highway Patrol (CHP) Inspection Forms

When a vehicle is first put into service for transporting school pupils, an initial bus-inspection report (CHP form No. 294) must be completed by a safety specialist of the Motor Carrier Division of the California Highway Patrol. A copy of this initial report should be filed in a jacket or binder as part of the permanent record for that vehicle. The CHP motor carrier inspectors are required to make at least an annual safety inspection on each bus thereafter. A copy of each annual report (CHP

NAPA VALLEY UNIFIED SCHOOL DISTRICT
1340 Menlo Ave. — Napa, California
TRANSPORTATION DEPARTMENT

ORDER No. 20

Dept. | Date

Type & Model

Year | License # | Equipment #

Serial # | Speedometer

Written by

Mechanic	Duties Performed

ADDITIONAL MATERIAL USED

Quan.	Part No.	Description	Price			
		TOTALS				

LABOR RECORD

Employee Name	Cost per hr.	Elapsed Time	TIME CLOCK
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
TOTALS			

LABOR RECORD

Employee Name	Cost per hr.	Elapsed Time	TIME CLOCK
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
			Off
			On
TOTALS			

SAMPLE

Fig. IV-3. Sample shop repair work order

form No. 343A) should also be added to the permanent file for the vehicle.

Acountability and Evaluation of Records

Good recordkeeping and retrieval of records are just as important as the maintenance of the physical plant. If a needed record is difficult to find or if it cannot be found at all, the record-keeping system has failed to perform its function. The main function of a record-keeping system is to provide for the efficient storage and retrieval of required information. One good method of keeping the required records is to make up an individual folder or binder for each vehicle in the fleet and then to file all records relative to that vehicle in an orderly manner in that individual folder.

Officials of the California Highway Patrol may inspect and evaluate the required records at any time during the year.

California Highway Patrol (CHP) Motor Carrier Safety Operation Program

The main objective of the Motor Carrier Safety Operation Program conducted by the California Highway Patrol is to prevent accidents involving buses and trucks because of mechanical defects and excessive driving hours. In this effort, the California Highway Patrol places emphasis on the following:

1. Adequacy of carrier maintenance programs
2. Vehicle equipment and condition
3. Compliance with CHP regulations relating to drivers' logs and hours of service
4. Maintenance of records and drivers' vehicle-condition reports
5. Inspection of motor-carrier terminals

As a result of inspections by CHP motor-carrier safety specialists, each carrier is given an A, B, C rating as follows:

1. *"A" Carrier*
   An A-rated carrier is one who is in compliance at the annual inspection in all areas and who can be expected to maintain a high level of compliance until the next annual inspection.

2. *"B" Carrier*
   A B-rated carrier is one with minor deficiencies but one whose overall compliance is within reasonable bounds.

3. *"C" Carrier*
   A C-rated carrier is one who gives evidence of widespread noncompliance with regulatory requirements or disregard of regulatory requirements.

   Although any single extremely serious factor could warrant assignment of a "C" rating, normally this rating would be reserved for carriers who give evidence of two or more of the following:

   a. Serious vehicle or equipment violations of a deliberate or long-standing nature
   b. Numerous "out-of-service" conditions
   c. Vehicle maintenance records or drivers' vehicle-condition reports not maintained
   d. Widespread equipment violations which by their nature should have been detected and corrected under an acceptable inspection maintenance program
   e. Serious lack of compliance with hazardous-materials requirements
   f. School Pupil Activity Bus operators:
      (1) Failure to use drivers' logs or time records
      (2) Failure to maintain current drivers' logs or time records
      (3) Failure to maintain on file for one year drivers' logs or time records
      (4) Excessive drivers' hours of service
      (5) Falsified drivers' logs
      (6) Many incorrectly prepared drivers' logs
      (7) Evidence of refusal or inability to comply with requirements

Summary

Recordkeeping is a very important part of any maintenance program, and it serves many purposes besides meeting the legal requirements for inspection and maintenance records. Some degree of flexibility may be necessary in developing the required record-keeping forms to meet individual needs. The daily pretrip inspection list; the weekly vehicle inspection report; the daily vehicle condition report; and the "A," "B," "C," and "D" checklists should include, not only the basic items, but also all special equipment in or on a vehicle. This would include, for example, special lifts, ramps, wheelchair stations, and wheelchair tie-down equipment.

Chapter V
Shop Facilities, Equipment, and Personnel

This chapter contains information and suggestions regarding the facilities, equipment, and personnel needed for shop maintenance and repair of school buses. The school board or the contract operator, depending on who owns the buses, must decide whether to own and operate a maintenance and repair facility or whether to contract or let out the work to a commercial repair facility. Information given here should help the bus owner or operator to make the best decision. For those who choose to set up and maintain their own shop, information is also given on shop layout, basic equipment needed, and the selection and training of mechanics.

Operator Maintenance Versus Contract Maintenance

The size of the fleet and the total miles driven during the year will, to a large extent, determine the practicality of performing one's own maintenance. If the fleet is large, the capital expenditures for maintenance facilities, tools, and equipment can be spread over a larger base, which would lower the per-unit cost of overhead. In general, if the fleet consists of fewer than ten buses, the operator should consider contracting or letting out the maintenance. A school district operating a small fleet might give consideration to contracting its school bus maintenance with another district that may already have adequate facilities. Operators of fleets of ten or more vehicles should find it advantageous to have their own maintenance and repair facilities. The decision to perform the maintenance and repair work, rather than contracting or letting it out, will also be influenced by such factors as the availability and cost of labor (including costs for recruitment and training); the investment required for an adequate parts inventory; the expected workload and work flow; and the availability of a commercial shop that can provide quality work, on time, and at competitive cost.

An operator who contracts or lets out repair work should furnish the garage or service station with the correct repair orders and complete instructions regarding the work to be done. Also, because the personnel of a commercial garage or service station may not know the laws and regulations relating to school-bus maintenance, the completed work must be inspected by someone who does know the laws and regulations to ensure that the buses will be safely and correctly maintained. This responsibility for inspection remains with the fleet operator or owner.

Size of the Maintenance Facility

The size of the maintenance facility will vary as the fleet size varies and as the maintenance functions expand to include more detailed operations. Space requirements also vary, but the general understanding is that 40 buses of the 79-passenger type can be parked on one acre if suitable access to the parking area is available. The amount of additional space needed for a maintenance and repair facility will depend on the size of the fleet.

Whenever a specific maintenance function increases sufficiently, the operator should analyze costs to determine whether the investment in tools, equipment, and personnel necessary to perform the work is economically justified. In some instances, the best method may be to contract or let out certain kinds of work.

When analyzing the cost of having repairs performed at an outside shop, the operator or owner should include the expense of transporting the vehicle to and from the maintenance and repair facility as part of the total repair cost. Also, the knowledge, expertise, and reputation of a maintenance and repair facility should be carefully scrutinized before a decision is made to place work there. An important question to consider is, "Will the maintenance and repair facility stand behind its work?"

Scheduling the Work

Correct scheduling of the workload is essential for maintaining a smooth operation in the maintenance and repair facility. If scheduling is neglected, peaks and valleys will develop, resulting in slack periods or unproductive periods. Uneven and irregular work flow is one of the most valid reasons for contracting maintenance and repair work. This might be the case, especially regarding tire work.

Many tire companies will provide complete tire service for all tires in the fleet—installation, maintenance, and repair—on a contract basis. This solves a work-flow problem for the operator, and it also eliminates the risk of injury to shop personnel in mounting and demounting tires.

If a school bus or school pupil activity bus is in use every day, maintenance work on the vehicle must be done during the hours when it is not being used to transport students. This could leave only from two to four hours per day to accomplish the necessary maintenance work without adopting a maintenance schedule that involves after-school hours.

Quality Control

Quality of repairs must not be sacrificed for speed. If not enough time is available for performing maintenance work during the day, then consideration must be given to having spare buses in the fleet or to performing the maintenance during after-school hours, such as in the evenings, or on weekends.

Whether the maintenance and repair work on a school bus is done in the fleet operator's own maintenance and repair facility or is contracted to a commercial facility, the work must be of high quality. This is essential for the safety of the bus and its occupants. In addition, quality work provides an economic advantage: poorly done repairs must be redone, which drives up costs. For example, an incomplete or ineffective engine overhaul would probably have to be redone a few months later on a premature schedule. The operator would find it less expensive in the long run to pay more for a higher quality, more thorough job.

A poorly done repair job could be the direct cause of an accident; however, if a poor repair job is not the direct cause of an accident, it could lead to a road breakdown, destroying the reliability that is of prime importance in a school-bus system. Road breakdowns and emergency repairs are costly and inefficient, and they create a poor public image. More importantly, they create a hazardous condition, since a stalled bus with its load of students becomes a traffic hazard. Such a hazard or distraction in the normal traffic flow is often the cause of an accident.

Tools, Equipment, and Parts

Tools, equipment, and parts inventory represent a substantial investment for a school-bus fleet operator or owner. Tool purchases should be guided by careful consideration of how often the tools are to be used and what their normal life span is to be. Some tools are usually supplied by the mechanic, and others are usually supplied by the fleet maintenance and repair facility. However, this division of responsibility for providing tools will vary from fleet to fleet, and it will depend to some extent on the level of maintenance to be performed.

Most equipment purchases should be amortized. That is, they should be depreciated over a number of years so that their total cost is spread out during their normal life span.

The parts inventory should be kept at a minimum. Consideration should be given to having the parts supplier, rather than the maintenance department, stock many of the parts being used. However, fast-moving parts and parts that are difficult to obtain should be kept in stock to reduce the number of trips to the parts supplier. The parts inventory should be reviewed periodically and adjusted to reflect changing needs. When equipment changes are made, the parts inventory should be analyzed to determine whether some of the stock has become obsolete. Parts that have been put into inventory and that are subsequently found to be unnecessary should be returned for credit as soon as possible, even though the supplier may assess a 10-percent handling charge. This way, the parts inventory will remain current, and money will not be tied up needlessly.

Overhead Costs

In comparing the total cost of repairs or maintenance done at one's own facility with the cost of similar work done at an outside repair facility, the fleet operator should not neglect to develop and use an accurate overhead figure. Items such as supervision (direct and indirect), rent, taxes, and utilities must be analyzed and prorated on some systematic basis to obtain a realistic overhead figure. The services of a cost accountant can be helpful in arriving at an accurate overhead figure for an operation.

School bus maintenance costs should include expenditures for all bus supplies, repairs, and routing service, including inspections, except those costs that arise directly from an accident. Accident costs should be recorded separately so as not to distort the true cost of maintenance in the fleet.

Buildings and Fixtures

Maintenance and repair buildings—either owned or rented—are desirable for the storage, service, and repair of school buses and for protecting the

vehicles against the elements and against acts of vandalism and thievery. The buildings should if possible be centrally located, making inspection of the buses and supervision of the buildings easier.

The efficiency of a service faciltiy will be enhanced by keeping the building clean, correctly heated, and well lighted. Windows should be washed often, and light bulbs should be replaced as they burn out. Building fixtures, such as door closers, should be kept in operating condition. If every part of the facility is neat, clean, and in good working order, the same conditions are more likely to prevail in the buses. Greases and lubricants should be kept in protected, labeled containers to prevent their misuse or contamination; and they should be readily available for use by the mechanics.

Availability of Labor

Another factor that must be considered in setting up a maintenance and repair facility is the availability of labor, both skilled and unskilled. Are enough mechanics available in the area, and what are the prevailing wage rates? Are any trade or vocational schools located in the area to serve as a source of mechanics?

The degree of specialization required for the mechanic will depend on the level of maintenance in the facility. If the main tasks in the program are to be such routine maintenance tasks as lube work, oil changes, tune-ups, replacement of tires, belts, and lamps, brake adjustment, exhaust-system repair, minor body work, and general upkeep of the school bus interior, a good general mechanic will be the most valuable person to employ. However, if the maintenance program also includes skilled rebuilding and repair, such as the repair of alternators or carburetors, engine rebuilding, major body work, and complete electrical or air-brake system repair, specialists in these trade areas must be trained or hired. The specialized training and equipment required for such work as electrical repairs may not be justified in a small fleet; however, as the number of vehicles in a fleet increases and the work attains sufficient volume, the investment in training, tools, and equipment will be economically sound.

Shop Layout and Basic Equipment

If the operation warrants setting up a maintenance and repair facility, the shop layout and equipment should include at least the following:

1. Tire-work area
2. Machine-shop area
3. Lubrication and preventive-maintenance area
4. Working stalls and work counters
5. Parts room
6. Bulky-parts storage
7. Wash rack
8. Discard area
9. Fuel storage area
10. Oil storage
11. Driver and mechanic rest area
12. Toilet and washroom facilities
13. Office

These listed items are the basic requirements for starting up a shop facility. The list may be expanded in accordance with the amount and type of work that will be performed.

Tire Work Area

An area for tire work should always be included in the plans for a maintenance and repair facility. The tire area need not be large or extensively equipped if the tire work is contracted or let out, as is often done in small fleets. However, certain minimum facilities for tire service will be needed in any repair facility. An adequate supply of regulated compressed air will be needed to operate impact wrenches and other pneumatic tools. If the fleet includes a full range of tire and wheel sizes, large and small impact wrenches will be needed, each adjusted to apply the correct torque to the lug nuts to prevent distorting the brake drums. Sockets for large lug nuts should be heavy-duty types.

If tire repair and replacement are to be done in the shop, some type of tire remover (air operated or electrically operated) will be needed. Tire inflation gauges and a tread-depth gauge will be required. (Tire pressures and tread depth must be recorded during preventive maintenance checks, so that tire wear can be monitored and tire needs can be projected.) Other basic tools and materials needed for tire servicing include a wire brush for cleaning wheels; blocks and jacks (heavy duty for large wheels); a supply of flaps, tubes, and valve cores; and soapy lubricant to ease tire installation. A tire spreader may be required for inspecting tire-casing interiors, especially for large tires.

In small fleets, hiring a full-time tire marker may not be justified. In such a case, the tire work should be contracted or let out on bid, to the operator's specifications, on an annual basis. The outside contract could include the supplying of new and recapped tires as well as performing tire service. An operator who chooses to contract or let

out tire work, or any other maintenance work, must maintain strict control over all outside maintenance items. The responsibility for quality maintenance remains with the operator.

Tire storage in the shop area should be limited to one or two tires of each size for immediate use. Bulk storage should be provided for in the warehouse or in some other suitable storage area.

Machine-Shop Area

Most service facilities include a general machine-shop area. The best use will be made of this area if it is conveniently located and contains the necessary equipment. The selection of tools and equipment for this area normally includes cutting torches, welders, a welding table, a bearing press, a punch machine for brake repair, a drill press, a grinder, and a small lathe. An adequate number of electrical outlets of correct voltage and current ratings must be provided in the shop area.

Because welding and cutting are commonly done in the machine shop, the machine-shop area should be located away from places where flammable materials are kept. Often, the machine-shop area and the tire-work area can be in the same stall.

Lubrication and Preventive Maintenance Area

Safety checks, lubrication, and other preventive maintenance activities make up a large part of the services performed in a maintenance and repair shop. Most work of this type is best done with the vehicle up on a hoist. Having a mechanic use a creeper to perform under-chassis inspection and maintenance work is no longer done.

The lubrication and inspection work area should be set up so that the mechanic does not have to make any unnecessary steps and so that the necessary tools will be readily available. This can be accomplished by providing overhead reels for the hoses and cables that furnish grease, oil, water, air, lights, and electric power. A workbench with a parts washer should be provided in the lubrication area. The workbench shelves and drawers should contain spare tools, blocks, paint, and numerous miscellaneous items. Bulk lubricants should be stored in a suitable area outside the shop. Transfer of lubricant is made easier and housekeeping is improved if lubricant drums are equipped with pumps.

If the shop has three bays, consideration should be given to locating the hoist in the center bay. This location of the hoist will provide access to each side of the school bus for removal of wheels, axles, and heavier components such as the engine, which may require a fork lift for removal.

Work Stalls and Work Counters

If the operation can justify having a maintenance and repair facility, the number of school buses in the fleet will determine how extensive each service area must be. At least two working stalls will be needed for a fleet of ten or more vehicles. Work counters located at the end of each stall are of great assistance to the mechanics in performing their daily jobs, and the storage space under the counters will encourage good housekeeping habits.

Parts Room

Every maintenance and repair facility for maintaining a fleet of school buses must have an area for parts and supplies. The parts room should be planned and laid out so that a systematic method of parts storage can be used. Parts will be easy to find if they are stored in a systematic and orderly way. Such storage not only speeds the repair work but also simplifies the task of taking parts inventory. An inventory-control system, such as a card file, should be set up, and a supply book listing all parts should be maintained for ready reference. The card file and the supply book should be kept current.

The following points should be considered in determining the quantities of parts and supplies to be kept on hand:

1. Ability of vendors to supply parts on demand
2. Geographic location of the maintenance and repair shop (nearness to vendors)
3. Number of spare school buses in the fleet
4. Amount of capital outlay available for parts
5. Cost advantage of large purchases of fast-moving parts, such as tires and batteries
6. Amount of inventory control desired

Control of the parts inventory is essential, and a decision must be made regarding the amount of money that will be spent for inventory control. Obviously, a parts room that contains only a few thousand dollars worth of parts does not warrant a full-time parts employee. A continuous review of the parts system should help to determine the need for a full-time or part-time employee.

The availability of parts has a direct bearing on the number of spare buses that will be needed in a fleet. If parts are readily available from a nearby vendor or from the fleet operator's supply room, repair jobs can be accomplished without delay; and downtime for the vehicles will therefore be reduced.

Bulky Parts Storage

A need exists in all maintenance and repair facilities for the storage of bulky items, such as tail pipes, mufflers, air-system parts, and extra seats. Provision should be made in the shop area or warehouse for correct storage and control of these items.

Wash Rack

Cleanliness of the vehicles in a fleet is important not only to present a good appearance but also to maintain visibility for the driver and the passengers, to preserve the legibility of vehicle markings and the function of lights and reflectors, and to facilitate inspections.

Provision should be made for washing the vehicles on a regularly scheduled basis. The capital investment will be low if the vehicles are washed by hand. However, washing a 35-foot bus by hand takes about 30 minutes, so the annual labor cost for hand-washing a large fleet can be significant. Depending on a number of factors, a washing machine for cleaning school buses might be feasible. The number of buses in the fleet and the number of years the washing machine will be operational are important factors in making the decision to purchase a washer. The public relations value of a clean fleet is also an important consideration.

A wash rack with a hoist will probably be one of the most often used facilities in the shop. A steam cleaner or chemical wash can be incorporated in the wash-rack area for cleaning engines, undercarriages, and other large parts. All parts of the vehicle must be cleaned so that oil leaks and other problems can be seen readily during visual inspections.

Discard Area

One or more wooden bins, constructed so they can be moved by a fork lift, should be provided in the shop to encourage good housekeeping. The discarded materials collected in the bins may be sold to scrap dealers.

Discarded parts and junk should not be allowed to accumulate in the shop. Such an accumulation reflects on the housekeeping of the facility, creates a fire hazard, interferes with the work flow, and creates a potential source of injury to the shop personnel.

Fuel Storage Area

The tanks in the fuel storage area should be large enough to provide the advantages of large fuel drops and the price breaks that usually accompany them. However, diesel fuel should not be kept in storage tanks for long periods of time, because prolonged storage has an adverse effect on diesel fuel.

Items to be considered in planning a fueling area are ease of access to the pumps; ability to fuel more than one vehicle at a time; speed of the pumps; provision for oil, water, air, cleaning materials, and a trash receptacle; and correct lighting if the area is to be used at night. A concrete pad makes the best type of parking surface for fueling purposes. Other types of road material are deteriorated by fuel spillage.

Some type of control should be adopted for accountability of the fuel supply—for example, an assigned-key system, a ticket-punching system, or a fuel log.

Oil Storage

If the size of the school bus fleet warrants this, large tanks should be installed for engine-oil storage, since a considerable saving can be made by purchasing oil in large quantities. However, operators of small fleets may have to buy oil by the barrel, but they can offset this price disadvantage to some extent by purchasing a year's supply of oil at a time on a competitive-bid basis.

Used oil can be resold, especially in large quantities. It should be stored in a tank large enough to make the quantity worthwhile to the used-oil buyer.

Driver and Mechanic Rest Area

A rest area for lunch and other break periods should be provided for bus drivers and the maintenance personnel. The rest area should be furnished with an adequate number of tables, chairs, and lockers, and it should not be located within the maintenance and repair area. To save the drivers from injury and prevent distraction of the mechanics, drivers should not be allowed in the maintenance and repair area.

Selection and Training of Mechanics

When a mechanic is selected for the maintenance and repair area, careful consideration should be given to the level of work the mechanic will be required to perform. A journeylevel mechanic can be expected to perform, with minimum supervision, all the general tasks required in a maintenance and repair facility. However, specialized repairs may require a mechanic with specialized training. A common mistake made by some super-

visors is to place a mechanic with limited experience on a job that is beyond the mechanic's capabilities. Also, a mechanic should not be hired until an appropriate place has been provided for the mechanic to work. A stall or other suitable work space should always be available for every mechanic.

Number of Mechanics Required

In most fleets that have ten or more school buses, at least one full-time mechanic will be required. In general, one journeylevel mechanic can adequately maintain up to 15 large school buses that are running normal mileage. Smaller equipment (24-passenger to 66-passenger buses) can usually be maintained with a ratio of one mechanic to 20 buses. Small, van-type vehicles that are running normal mileage can usually be maintained with a ratio of one mechanic to 25 vehicles. Increases in mileage will proportionately increase the requirement for mechanics.

As the school bus fleet size increases, the need will increase for such additional personnel as helpers, tire servicers, parts persons, bus washers, utility personnel, and maintenance supervisors.

Inservice Training of Mechanics

Although mechanics new to the organization may be experienced journeylevel mechanics, they are not likely to be familiar with the laws and regulations relating to the inspection and maintenance of vehicles used for pupil transportation. Also, they may be unfamiliar with the specific mechanical features of the buses. Therefore, all mechanics hired for the maintenance and repair facility must have training in the special field of school bus maintenance. This training will enable the mechanics to undertake new responsibility and expand their experience.

Training to increase the efficiency of the maintenance and repair staff may be accomplished in several ways. Schools operated by the equipment manufacturers are one training resource, and adult-education classes are another. Also, the fleet operator must participate in training by holding inservice training classes. Inservice training is often neglected, but the operator who makes a conscientious effort to provide such training will be rewarded with fewer breakdowns, better-maintained equipment, and lower costs.

Maintenance supervisors usually have high mechanical ability, but they may require training in management techniques. The operator should therefore include supervisors in the inservice training program.

Service Truck

Fleets operating ten or more buses may find having a service truck very helpful. A light panel truck, equipped with hand tools, small parts, and supplies may be most useful. Mechanics may use such a truck in making emergency repairs to buses that have broken down on the road.

Since most school buses do not carry spare tires, tire trouble enroute is a common type of problem that can be solved with the service truck. The service truck can also be used to obtain parts and supplies from local vendors. In some areas of the state where county school systems are widely dispersed, school bus fleet operators may find advantageous having a complete service shop on wheels. This will allow the mechanic to go with all of his or her tools, parts, and supplies to the various locations where buses are garaged. In more compact areas the preferred method is to bring the bus to the maintenance and repair facility for attention rather than have the mechanic spend time traveling to the bus.

Normally, wreckers or tow trucks are not recommended as necessary equipment in a school bus fleet. Because they are needed only on rare occasions, tow trucks or wreckers are usually more economical to rent than to own. In most instances where a damaged or malfunctioning bus cannot be driven back to the repair facility, a mechanic using the service truck can restore the vehicle to operating condition in a relatively short time. Also, if a vehicle should become stuck in the mud or snow, another bus driven by a mechanic may be used for towing; but this should be considered only as an emergency procedure. Drivers should not try on their own initiative to extricate another bus without authority from the fleet-maintenance superintendent.

Useful Publications

The most complete publication available as an aid to the school bus repair and maintenance program is the chassis manufacturer's maintenance and inspection manual. The body manufacturer also will have available a complete manual on body components, maintenance, and inspection. These manuals are available free, or at moderate cost, from the manufacturers through their distributors.

Several other publications that can be valuable aids in a school bus maintenance program are listed in the Selected References section of this guide.

Selected References

Laws and Regulations

1. California Administrative Code, Title 13, Motor Vehicles, which contains Subchapter 6.5 of Chapter 2, Motor Carrier Safety, may be purchased from the State of California, Documents Section, P.O. Box 20191, Sacramento, CA 95820.
2. *The California School Bus Driver and Carrier Handbook* will be available from any field office of the California Highway Patrol after September, 1978.
3. State of California Vehicle Code (current edition). For sale at all offices of the Department of Motor Vehicles.
4. *Vehicle Equipment Inspection Guide* (HPG. 83.2). Available from the California Highway Patrol, Office Services Section, P.O. Box 898, Sacramento, CA 95804.

Periodicals

1. *Commercial Car Journal.* Published by Chilton Co., Chestnut and 56th St., Philadelphia, Pa.
2. *Fleet Owner.* Published by McGraw-Hill Publishing Co., 330 West 42nd St., New York, N.Y.
3. *School Bus Fleet.* Published by Bobit Publishing Co., 1155 Waukegan Rd., Glenview, Ill.

Reports

1. *National Minimum Standards for School Buses.* National Commission on Safety Education, 1201 Sixteenth St. NW, Washington, D.C.
2. *National School Bus Report.* National School Transportation Association, P.O. Box 324. Fairfax, Va.

Publications Available from the Department of Education

School Bus and School Pupil Activity Bus Inspection and Maintenance Guide is one of approximately 400 publications which are available from the California State Department of Education. Publications of interest to the users of this document are the following:

Administration of Public School Transportation (1972)	$1.25
Administration of the School District Budget (1975) (*includes 1977 supplement*)	1.75
Administration of the School District Risk Management Program (1977)	2.50
Attendance and Enrollment Accounting in California Public Schools (1977)	2.80
Bicycle Rules of the Road in California (1977)	1.50
California Guide to Traffic Safety Education (1976)	3.50
California Public Schools Selected Statistics, 1976-77 (1978)	.65
California School Accounting Manual (1976) (*includes 1977 amendments*)	1.65
California Teachers Salaries and Salary Schedules, 1977-78 (1978)	10.00
Current Trends in Costs for School Districts (1977)	.65
District Paid Insurance Programs in California School Districts, 1977-78 (1978)	2.50
Liability Insurance in California Public Schools (1978)	2.00
Manual para Conductores de Vehículos para Trabajadores Agrícolas (1977)	.65
Manual of First Aid Practices for School Bus Drivers (1972)	.90
Site Management (1977)	1.50
Work Permit Handbook for California Public Schools (1976)	1.50

Note: The list prices include charges for mailing and handling. Purchasers in California should add sales tax. Checks should be made payable to the California State Department of Education. Only purchase orders from government agencies in California will be accepted without a remittance; special agency invoices or voucher forms received without a remittance will *not* be accepted. All sales are final.

Orders for publications should be sent to:

Publications Sales
California State Department of Education
P.O. Box 271
Sacramento, CA 95802

Persons wanting to purchase Department of Education publications in person in Sacramento may do so at the cashier's window, mezzanine, Downtown Plaza Building, 515 L Street, weekdays between 7:30 a.m. and 4:45 p.m. (Public parking is available beneath the building.)

Telephone inquiries should be made to 916-445-1260 or 916-445-3497.

A complete list of publications available from the Department may be obtained by writing to the address listed above.

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